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(51) INT CL<sup>6</sup>

G06F 3/153

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(56) Documents Cited

Microsoft (R) File Manager Version 4, 1981-1996,  
Microsoft Corp

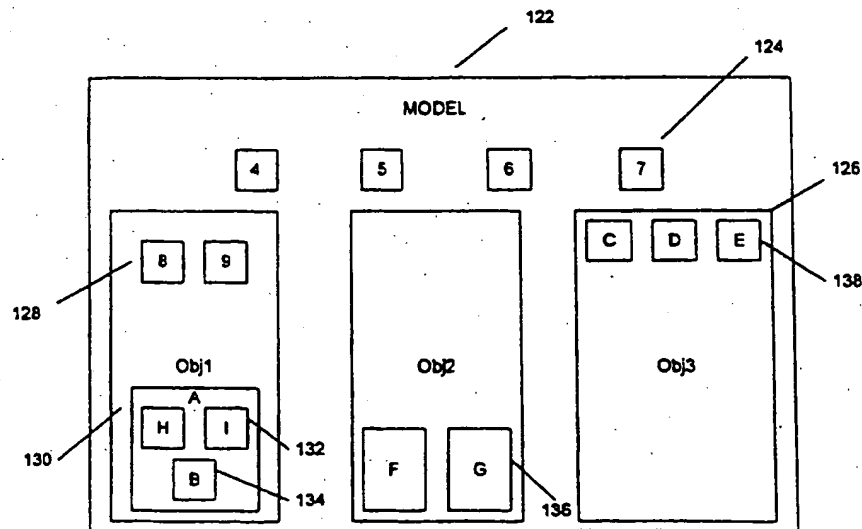
(58) Field of Search

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(54) Abstract Title

**HIERARCHICAL NODE STRUCTURE**

(57) The present invention discloses a method and apparatus for displaying a visual hierarchy of nodes. A top level node in the hierarchy is displayed as a window and lower level nodes are displayed within an area of the top level node. Lower level nodes are either expanded or unexpanded. Unexpanded lower level nodes are displayed in one area and expanded lower level nodes are displayed in another area. The unexpanded nodes conceal their contents and the expanded nodes disclose their contents, so that a visual hierarchy of nodes can be displayed on a single display screen. The expanded nodes can contain several layers of lower level nodes that are visually formatted like the window.



**FIG. 2**

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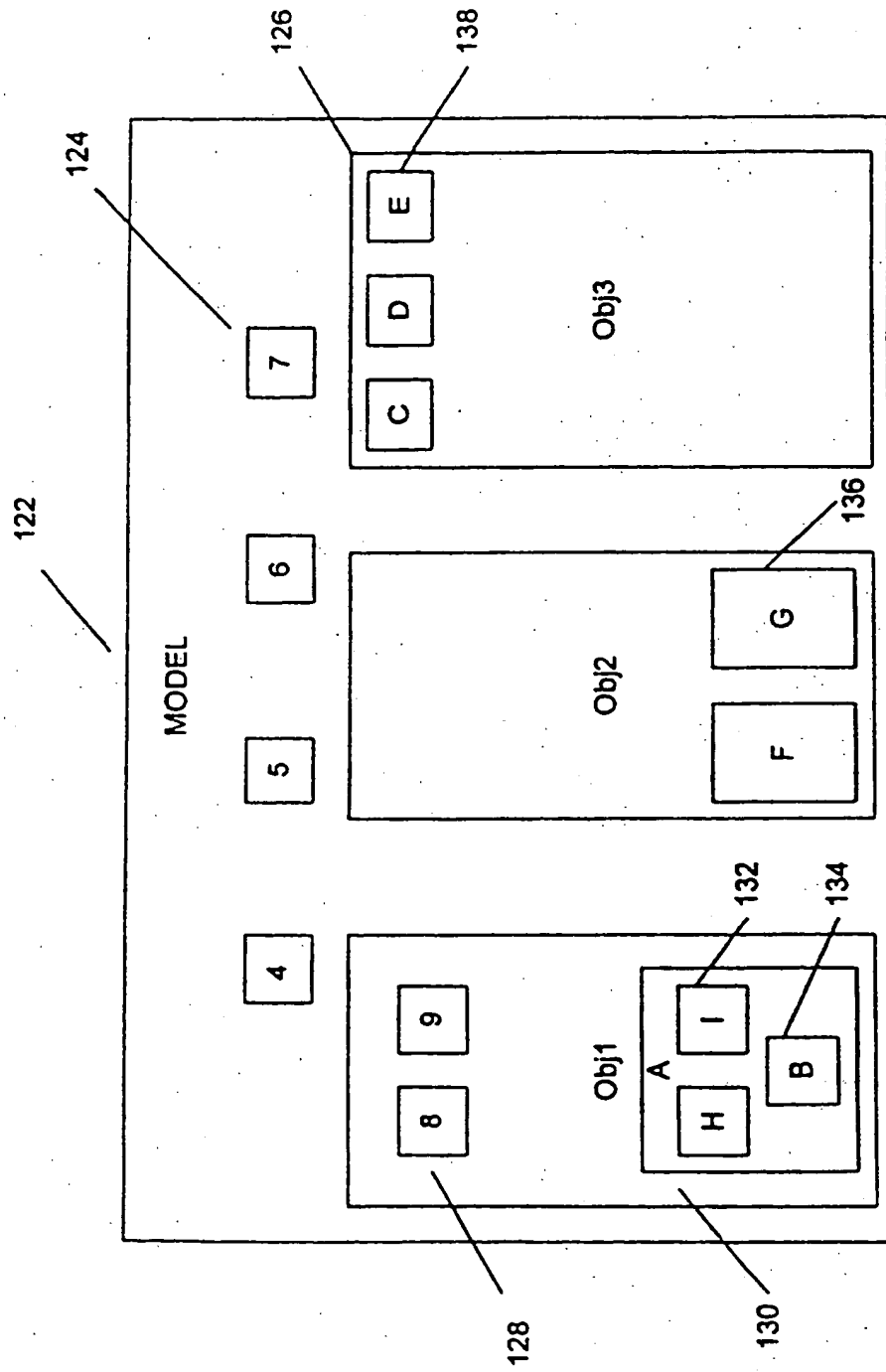


FIG. 2

## HIERARCHICAL NODE STRUCTURE

This invention relates generally to hierarchical systems, and in particular to a fractal nested layout for hierarchical systems.

5 Computer systems frequently organize data as hierarchical information structures. An example is a directory of files provided by a typical operating system. It usually contains a root directory, which consists of files and sub-directories. Each sub-directory also contains  
10 files and lower-level sub-directories. To aid a user in navigating between files and sub-directories, hierarchical structures are represented graphically as trees.

15 Similarly, object-oriented programming environments represent hierarchical data in a tree-like manner. In the case of a large hierarchy, this graphical representation occupies an area larger than can be displayed on most monitors. To navigate between objects, users must scroll up and down through several windows worth of data. Because each window shows only a portion of the tree, users may become confused about  
20 how a specific portion relates to the total hierarchical structure.

Thus, there is a need in the art for a graphical representation that displays a total hierarchical structure in a compact display area of a monitor.

25 To overcome the limitations in the prior art described above, and to overcome other limitations that will become apparent upon reading and understanding the present specification, the present invention discloses a method, apparatus, and article of manufacture for a fractal nested  
30 layout in a hierarchical system.

The present invention displays a visual hierarchy of nodes on a monitor connected to a computer. The present invention comprises the steps or elements of displaying a top level node in the hierarchy as a  
35 window on the monitor and displaying several lower level nodes within an area of the top level node. Lower level nodes are either expanded or unexpanded. The unexpanded lower level nodes are displayed in one area and the expanded lower level nodes are displayed in another area. The unexpanded nodes conceal their contents and the expanded node disclose their contents. The expanded nodes can contain several layers of lower  
40 level nodes that are visually formatted like the window.

which are its subnodes. The subnodes of an expanded node may themselves be displayed in an unexpanded or expanded manner, as desired, on an individual basis. Alternatively, a node can be displayed in another format, such as a window, list or outline embedded in the expanded hierarchy. The user may zoom and fan the hierarchy. As subnodes are expanded, they themselves become nodes and thus show their contents as subnodes. In this manner, the user may drill down through the one or more levels at a time, until the lowest possible level in the hierarchy is itself displayed.

Nodes may also be links to other nodes. In the linked case, the linked nodes are followed. Any loops (expanding the same node twice) may be terminated by not expanding the node. This option may be exercised by the user or by a pre-determined configuration.

Incidentally, nodes need not be homogenous in their representation. For instance, it is possible to mix objects and folders in a single hierarchy.

FIG. 1 illustrates an exemplary computer system 100 that could be used to implement the present invention. The computer 102 comprises a processor 104 and random access memory (RAM) 106. The computer 102 may be coupled to other devices, such as a monitor 108, a keyboard, a mouse device, a printer, etc. Of course, those skilled in the art will recognize that any combination of the above components, or any number of different components, peripherals, and other devices, may be used with the computer 102.

Generally, the computer 102 operates under the control of an operating system 110 stored in the memory 106. The present invention is preferably implemented using one or more data structures and computer programs operating under the control of the operating system 110. More specifically, the present invention comprises a hierarchical modeling tool 112 which operates under the control of the operating system 110. This hierarchical modeling tool generates a fractal nested layout 114 that includes a node hierarchy 118.

In the preferred embodiment, the operating system 110, the hierarchical modeling tool 112, the fractal nested layout 114, and the node hierarchy 118 are tangibly embodied in a computer-readable medium, e.g., random access memory 106 or data storage device 120, which could

Obj1 contains two unexpanded subnodes ( 8 , 9 ) 128 and one expanded subnode ( A ) 130, which further contains two unexpanded subnodes ( H , I ) 132 and one expanded subnode ( B ) 134 which contains zero subnodes. Obj2 contains zero unexpanded subnodes and two expanded subnodes ( F , G ) 136, each of which contain zero subnodes. Obj3 contains three unexpanded subnodes ( C , D , E ) 138 and zero expanded subnodes.

As described above, the hierarchy is comprised of a plurality of levels, wherein each level includes a set of nodes, and each node may contain a plurality of subnodes. Each subnode itself may contain a plurality of levels, wherein each of the levels may contain a plurality of subnodes. As subnodes are expanded, they themselves become nodes and thus show their contents as subnodes. In this manner, the user may drill down through the plurality of levels to display more information concerning the hierarchy, until the lowest possible level in the hierarchy is itself displayed.

FIG. 3 is a flowchart illustrating the operation of the present invention.

Block 140 represents the computer 100 displaying a top level object as a window on the monitor 108 attached to the computer 100.

Block 142 represents the computer 100 displaying lower level objects within an area of the top level object. Lower level objects may include both expanded and unexpanded objects, wherein expanded objects disclose their contents and unexpanded objects conceal their contents. Similarly, an expanded object's lower level objects can be unexpanded or expanded individually.

Block 144 is a decision block that represents the computer 100 determining whether other lower levels of objects should be displayed. If the computer detects the maximum depth, then the expansion display is terminated. The expanded objects can contain a plurality of levels, each containing one or more objects, that the computer 100 visually formats like the model 122.

If additional lower levels of objects are to be displayed, control returns to Block 142; otherwise, if no lower levels of objects are to be displayed or no lower levels exist, control is transferred to Block 146

## CLAIMS

1. A method for displaying a visual hierarchy of nodes on a monitor connected to a computer, comprising the steps of:

5 (a) displaying a top level node in the hierarchy as a window on the monitor; and

10 (b) displaying a plurality of lower level nodes within an area of the top level node, wherein the lower level nodes comprise a plurality of levels within the visual hierarchy, so that a plurality of unexpanded lower level nodes are in a first area and a plurality of expanded lower level nodes are in a second area, when the unexpanded lower level nodes conceal their contents and the expanded lower level nodes disclose their contents.

15 2. The method of claim 1, wherein the expanded lower level nodes are visually formatted like the top level node, when the unexpanded lower level nodes are in a first area and the expanded lower level nodes are in a second area.

20 3. The method of claim 1 or claim 2, wherein the visual hierarchy of nodes is a consistent display of the top and lower level nodes.

25 4. The method of claim 1 or claim 2, comprising the further step of selectively expanding and unexpanding the lower level nodes.

30 5. The method of any preceding claim, wherein the nodes may represent objects, folders, classes, packages, containers, archives, compressed files, windows, lists, tables, notebooks, dialogs, groups, collection, indices, matrices, states, and diagrams.

35 6. The method of any preceding claim, wherein the nodes are heterogeneous in their representation.

7. The method of claim 1, wherein the nodes in a first hierarchy may be linked to nodes in a second hierarchy.

40 8. A computerized apparatus for displaying a visual hierarchy of nodes, comprising:



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Claims searched: All

Examiner: R F King  
Date of search: 23 July 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.P): H4T[TBAX, TBLA, TBLX]

Int CI (Ed.6): G06F 3/00, 3/037, 3/153

Other: ONLINE: WPI, INTERNET

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	Microsoft (R) File Manager Version 4, 1981-1996, Microsoft Corp. See 'screen dump' of 'File Manager' display of multi level hierarchical tree structure, with expanded nodes always above and to left of unexpanded nodes, at all accessed levels.	1 and 8 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.